DISTRIBUTION, SPECIES COMPOSITION AND ABUNDANCE OF TREES AND LARGE WOODY DEBRIS ADJACENT TO AND WITHIN GAZOS CREEK

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INTRODUCTION

Large woody debris in the active channel is important for providing structure necessary for development of pools and backwaters, which are vital summer and overwinter habitat for coho salmon (*Oncorhynchus kisutch*) and steelhead (*O. mykiss*). Determination of the amount of wood present, and the likelihood of recruitment, are crucial factors in evaluating current habitat conditions and potential for restoration. Gazos Creek is one of three streams south of San Francisco that still supports a run of coho salmon (Smith 2001). A wood inventory was performed on Gazos Creek, along with three other streams, during 2001-2002.

METHODS

A total of 6.77 stream miles were surveyed for trees and large woody debris (LWD) on nine days in the late summer and fall of 2001, beginning at Highway 1 and ending approximately 400 feet upstream of the south fork confluence. On 5 and 6 September 2002, the entire length of the stream that had been sampled in 2001 was re-surveyed to monitor any significant changes that might have occurred since the previous fall, and to note the size, location and composition of all logjams spanning the channel.

Preliminary reaches were designated prior to sampling, based upon: Rosgen channel classification (especially gradient, substrate and entrenchment); substantial logjam and/or sediment impoundment impacts resulting from the severe 1998 El Niño winter; and upslope conditions. Distinctions among reaches were confirmed after analysis of data collected on channel and upslope conditions (Tables 1 - 3).

Reach 1 was judged to be relatively homogenous in terms of habitat and was sampled once per thousand feet (at the 400-600 foot segment) according to the protocol recommended by the California Department of Fish and Game (CDFG). All other reaches were much shorter and more heterogenous in terms of habitat; they were sampled twice per thousand feet (at the 200-400 and 800-1000 foot segments).

Stream-mile distances were measured using a hipchain, and beginning and end points of sample segments were flagged for future reference. Data were collected using a "LWD Inventory Form", which was modified from the form contained in the CDFG Salmonid Habitat Restoration Manual (Flosi et al., 1998). The CDFG form categorizes trees, logs and stumps in the bankfull channel or adjacent to the channel by length (6-20 feet, >20 feet), diameter (in one-foot

increments from 1 foot to >4 feet), and location (bankfull channel or upslope; left or right bank). All trees within the channel and/or 50 feet up the bank on either side are recorded by diameter as live or dead, and conifer or deciduous.

The new form was successively tested and modified over the course of the initial sampling performed on Gazos and Waddell Creeks, and all 2001/2002 samples reflect the final version.

The new form retains some of the parameters in the CDFG form, but is modified in several ways:

1. The category "perched" was applied to standing live or dead trees within the channel, or to trees or downed wood at the edge of the bankfull channel, which were likely to be recruited at high flows.

2. The out-of-channel area was split into two categories:
   a) riparian, an area beginning at the edge of the bankfull channel, of variable recorded width, and dominated by deciduous riparian trees (i.e., alder (*Alnus*)); and
   b) upslope, any area beyond the riparian zone but still falling within 75 feet of the bankfull channel.

3. Slopes (in percent) of the riparian and upslope zones were recorded separately.

4. Four new categories were created for LWD located within the bankfull channel:
   a) lowflow/pool for pieces in the lowflow channel which were creating or enhancing a pool;
   b) lowflow/extra for pieces in the lowflow channel which were present but not contributing to creation of pool habitat;
   c) bankfull/backwater for pieces in the remainder of the bankfull channel which were creating a backwater; and
   d) bankfull/extra for pieces in the bankfull channel which were present but not contributing to creation of backwater habitat.

5. Widths of the lowflow and bankfull channels and bankfull depths were recorded.

6. All logs, stumps and trees were recorded by code for species in the location that they occurred. Trees in several location categories were indicated accordingly with position of root shown.

7. Additional symbols represented:
   a) "Old", which was defined as a conifer that was missing bark and limbs, and showing evidence of decay;
   b) Logs that were within jams;
   c) Trees leaning in such a manner that they were likely to fall into the channel;
   d) Multi-trunked trees;
   e) Downed trees with rootwad attached;

f) Downed trees which were still alive; and
g) Probable source of recruited wood, if it was apparent.

Locations and sizes of logjams and other significant debris not falling within a sample site were also recorded. A clinometer was used to measure slopes. Upslope distances were determined using a laser-sighted range finder. Channel widths and depths, and tree/log diameters and/or lengths were measured using a folding stadia rod.

Field tallies were organized by reach and total piece counts were compiled. Since most reaches varied significantly in length, relative densities (pieces per thousand feet) for the lowflow and bankfull channels, and upslope habitats, were also calculated so that reasonable comparisons between the reaches could be made.

RESULTS

Stream Characteristics

In reach 1, between the mouth and Old Woman Creek, the channel is flat and the substrate is dominated by silt, sand and gravel. Above bankfull, the floodplain is relatively wide and flat with slopes of <50% on both the left and right banks (mostly Rosgen channel type C5). Upstream in reach 2, the channel is similar but substrate is dominated by gravel (Rosgen channel type C4). The floodplain narrows and becomes more entrenched in reaches 3 through 5C, and slopes on either bank increase markedly (see Tables 2 and 3). In reach 3, sediment deposition associated with 1998 logjams has caused channel aggradation, resulting in a wider bankfull channel and narrower lowflow channel (Table 2). Rosgen channel classification is primarily B4C, but some sections are entrenched enough to be considered F4, especially in reaches 5A through 5C. Reach 5B was also affected by logjam-related sediment deposition in 1998. At reach 5C, the channel is still a B4C but the bankfull channel is narrower and lowflow channel wider than in downstream reaches. In reach 6 (at Bear Creek), gradient increases in the narrow channel, and bedrock is the dominant substrate (Rosgen channel type B1). Reach 7 is a series of bedrock chutes and falls (Rosgen channel type A1). At reach 8, above the south fork confluence, the gradient decreases and cobbles dominate the substrate (Rosgen channel type B3). Further upstream, above the LWD surveys, the channel is steep and dominated by bedrock chutes and falls (Rosgen A1).

Large Woody Debris and Tree Distribution, Species Composition and Abundance

LWD and trees were both hardwood and conifer species. Conifer species present were Douglas fir (*Pseudotsuga menziesii*) and redwood (*Sequoia sempervirens*) and Monterey pine (*Pinus radiata*) , although the majority of coniferous trees and logs tallied were redwoods. The most common hardwood species are red alder (*Alnus rubra*), bigleaf maple (*Acer macrophyllum*), California bay laurel (*Umbellularia californica*) and tanbark oak (*Lithocarpus densiflorus*). Red alder made up most of the hardwood trees and logs tallied.

There were 1,540 out-of-channel logs and trees counted in the upslope, riparian and perched areas, of which 989 (64%) were conifers and 551 (36%) hardwood (Table 5). In general, trees were dominated by conifers in the upslope, evenly split between conifers and hardwoods in the riparian zone, and dominated by hardwoods in the perched (within or at the edge of the bankfull channel) (Table 5). However, reaches 1 and 2 were dominated by hardwoods (89% overall). At reach 3, the trend moved strongly and abruptly in favor of conifers.

There were 434 pieces of LWD in the sampled sections of active (lowflow and bankfull) channel, 314 (72%) of which were conifers and 120 (28%) were hardwoods (Table 4). In the lowflow channel, tallied pieces were mostly conifers (74% conifer, 26% hardwood). Distribution was similar in the remainder of the bankfull channel, (71% conifer, 29% hardwood). LWD responsible for habitat formation (pool or backwater) was also largely conifer (75% conifer, 25% hardwood). "Extra" LWD was largely conifer in the lowflow channel (74% conifer, 26% hardwood) but the difference was slightly less in the remainder of the bankfull channel (69% conifer, 31% hardwood).

Densities of LWD present in the active channel varied by reach and size. Two-thirds (65%) of all LWD tallied in the active channel was classified as extra (Table 4), and of that, most was conifer, greater than 2 feet in diameter and less than 20 feet in length (Table 6, Figures 1-8). Of the wood associated with habitat formation, conifers greater than 20 feet in length and with diameters of greater than 2 feet were predominant, but they were relatively scarce compared with smaller pieces. Smaller pieces of both hardwood and conifer were more numerous overall, and were more likely to be classed as "extra" than larger pieces. The conifer wood present was approximately 70% "old" redwood, with the remainder recent redwood and Douglas fir. Upstream of reach 2, all of the tallied hardwood consisted of red alder; willows and maples were tallied only in reaches 1 and 2.

Overall, conifer pieces greater than 2 feet in diameter were present in higher densities than other conifer or hardwood categories (Figs. 2 and 4), and hardwood pieces greater than 2 feet in diameter had the lowest densities (Figs. 6 and 8).

LWD Tallying and Classification of Value

It was common to encounter pieces of LWD which, due to length or positioning, were located in more than one category within the active channel and/or in upslope areas. There were also instances where LWD potentially behaved very differently during lower flow conditions (when these tallies were performed) than it might during higher flows. The LWD was tallied on the form to indicate the number of appropriate different categories it was in by making a hatch mark and drawing a line through and including any areas the LWD happened to be located in. For example, if a downed tree had its root in riparian dead/down and its crown in the bankfull channel/extra, a hatch mark would be made in riparian dead/down and a line drawn to bankfull/ extra to accurately indicate the position of the downed tree. For the inventory and analysis, it was necessary to develop and employ guidelines for the classification of the value of the tallied LWD. These guidelines took into consideration the need for accurately indicating the amount of wood currently present in the channel, its likelihood of recruitment, the functions it performed,

or had the potential to perform, as a result of its placement, and the wide range of conditions produced by varying seasonal flows.

a) Where LWD was found to be located in two or more areas of the active channel or upslope areas, it was classified as being located in the most "valuable" category in terms of habitat formation (i.e., a piece tallied as being located in both "bankfull/extra" and "bankfull/backwater" would be classified as being only in the "bankfull/ backwater" category;

b) Where downed trees were found to be spanning the channel, (i.e., suspended above the channel during low flows but potentially in the channel at high flows) they were classified as "bankfull/extra" rather than "perched, dead/down";

c) Downed trees in the perched, riparian or upslope areas which extended completely or partially into the active channel were classified accordingly to their channel value rather than as upslope "dead/down"; and

d) LWD located within the active channel was evaluated for its function during low flow conditions and its potential function at higher flows, and tallied appropriately. For example, if evidence of a backwater was noted adjacent to a piece or cluster of LWD, even if no backwater was present at the time of the survey, the LWD would be assigned to the category of "bankfull/ backwater" if the LWD was determined to have likely formed the backwater or contributed significantly to its formation at high flows.

Reach Comparisons

Reach 1. Beginning at Highway 1 and extending for 13,335 feet upstream to Old Woman Creek (Table 1), Reach 1 is dominated by hardwoods, and is flat with low entrenchment (Rosgen C5). The riparian areas on either bank are large (means = 52 feet left bank and 33 feet right bank) with moderate slopes (means = 57% left bank, 42% right bank) (Table 2). A total of 62 pieces of LWD (73% hardwood) were recorded in the active channel, and 212 logs and trees (90% hardwood) were present upslope in 13 samples (Table 4). Out-of-channel wood was concentrated in the riparian zone (53%), and riparian wood was overwhelmingly hardwood (Table 5). Most LWD associated with habitat features was also hardwood (83%), but conifer logs were relatively common compared to the scarcity of conifers upslope in this reach. Four leaning trees and 14 dead/standing trees were counted, all of which were alders located in the perched or riparian areas.

In-channel LWD densities were very low compared with other reaches (23.8 pieces per thousand feet). Conifer pieces were predominantly old redwood and were present at a density of 4.6 pieces per thousand feet, compared with 17.3 pieces per thousand feet for hardwood. The highest proportion (32%) of LWD was present as extra small hardwood less than 2 feet in diameter located in the bankfull channel (Table 6, Fig. 5). Over half (53%) of all LWD was classified as extra. Conifers were most likely to be present in the lowflow channel as extra (9% of overall).

Also of note were three large Douglas firs in sample 9 (8,400 feet upstream from Highway 1). Two of these trees slid down root-first from the left bank, forming two pools and a backwater, and one tree entered on the right bank, where its roots form a scour pool. These trees were all at least 6 feet in diameter and approximately 100 feet in length. They showed few signs of decay and probably entered the channel during the 1998 El Niño winter.

Reach 2. Beginning at Old Woman Creek and continuing for 4,000 feet upstream (Table 1), reach 2 was dominated by hardwoods in the riparian and upslope, but the majority (66%) of LWD in the active channel was conifer (Table 4). The channel is flat and relatively unentrenched (Rosgen C4). The riparian areas were similar in width to those of Reach 1 (means = 44 feet left bank, 37 feet right bank) but the upper slopes were gentler (slope means = 35% left bank, 36% right bank) (Table 2). A total of 65 pieces were present in the active channel, and 123 logs and trees were tallied out of the channel in 8 samples. Trees were present in roughly equal amounts in the perched and riparian areas but scarce in the upslope (Table 5) and were predominantly hardwood (88%). Twelve perched trees were deemed to be leaning, one of which was a dead/standing Douglas fir 1-2 feet in diameter in the riparian zone.

In-channel relative LWD densities were 40 pieces per thousand feet. Conifer pieces were predominantly old redwood and were present at a density of 27 pieces per thousand feet, compared with 14 pieces per thousand feet for hardwood. Almost two thirds (60%) of all wood present in the channel was conifer classified as extra (Table 6, Fig. 4).

At the time of the surveys, reach 2 contained 3 logjams, one of which was quite large (10 feet high by 81 feet long) and located approximately 0.5 stream miles upstream from Old Woman Creek. Most of the wood tallied for this reach was contained within this single jam. The jam formed during the 1998 El Niño winter and degraded somewhat after the December 2001 bankfull event. The stream cut through completely as a result of the December 2002 above-bankfull events and the logjam no longer spans the channel, but is remnant in the bankfull channel where much of the LWD remains.

Reach 3. Beginning approximately 3.25 stream miles upstream of the mouth, reach 3 is 2,000 feet long (Table 1), contains four samples and marks the transition from hardwood-dominance to conifer-dominance. The channel narrows markedly to a Rosgen B4C type, with means for the left and right bank riparian widths of 26 and 16 feet, respectively. Slopes, particularly on the left bank, are much steeper than downstream (means = 71% left bank, 64% right bank). The width ratio between the bankfull and lowflow channels (.21) is the lowest of any reach (Table 2). Large logjams formed downstream of this reach during the 1998 El Niño winter, which resulted in sediment accumulations in this reach and resulting bed aggradation, which is now being downcut.

A total of 53 pieces were counted in the active channel, of which 45 (84%) were conifers. There were 148 pieces tallied out-of-channel, of which 110 (74%) were conifers. Of the 110 out-of-channel conifers, 80 (73%) were located in the upslope.. Overall conifer numbers were much higher than in downstream reaches, and were also associated with the majority of wood-created habitats (Tables 4 and 5; Figs. 1 and 4). Ten leaning alders were tallied in the riparian zone.

In-channel LWD densities totaled 66.3 pieces per thousand feet. Conifer density was 56.3 pieces per thousand feet, compared with 10 pieces per thousand feet for hardwood. Small diameter conifers associated with pools made up the largest portion of LWD (15%), followed by large diameter conifers associated with backwaters (13%) (Table 6, Figs. 1 and 2). This reach included EPA sites G through I, and contained one logjam.

Reach 4. This reach begins 3.6 stream miles upstream of the mouth, was 867 feet in length and consisted of only one sample (Table 1). Riparian widths for the left and right bank were 30 and 15 feet, respectively, and upland areas were steep, with average slopes of 76% for the right bank and 85% for the left bank (Tables 2 and 3). No LWD over 1 foot in diameter was present in the channel in this reach, and a total of 53 pieces of out of channel wood were tallied, of which 37 (70%) were conifers located in the upslope area (Table 5).

Reach 5A. This reach begins approximately 3.8 miles upstream of the mouth and contains 13 sample sites in 6,685 feet (Table 1). The channel is still a Rosgen type B4C, but there are areas which are sufficiently entrenched to warrant an F4 classification. Means for the left and right bank riparian widths were 15 and 20 feet, respectively. Slopes, particularly on the left bank, are steep (means = 102% left bank, 90% right bank, Table 3).

The active channel contained 129 pieces of LWD, of which 97 (75%) were conifers (Table 4). There were 358 logs and trees counted in the out of channel areas, more than in any other reach. Of these, 256 (72%) were conifers and of these, 189 (74%) were located in the upslope areas (Table 5). Fourteen leaning trees were counted, of which three were redwood and one was a dead/standing perched redwood 2-3 feet in diameter. Seven other dead/standing trees were counted in the perched and riparian, of which two were redwoods.

In-channel LWD density was 49.6 pieces per thousand feet, with conifers dominant (33.8 pieces per thousand feet). Densities were highest (10.7 pieces per thousand feet) for large conifer LWD (diameters greater than 2 feet) associated with a pool (Table 6; Figs. 1 and 2). Density for large (greater than 2 feet in diameter) conifer LWD classified as extra in the bankfull channel was also high compared to other reaches sampled, at 8.8 pieces per thousand feet (Table 6; Figs. 6 and 8). This reach included EPA sites J through P, and contained 5 small logjams.

Reach 5B. Reach 5B is 1,148 feet long, contains two samples and begins approximately 5.1 miles upstream of the mouth. The riparian zone is extremely narrow, with average widths of only 9 feet on the left bank and 20 feet on the right bank (Table 3). This reach was very entrenched, with the lowest average lowflow channel width (7.3 feet) and one of the lowest lowflow width/bankfull depth ratios (.22) calculated for the stream (Table 2). At least part of the channel's cross-sectional shape in this short reach is due to bed aggradation resulting from sediment accumulations behind logjams that formed downstream in the winter of 1998. Average slopes were 95% on both the left and right banks. The channel was classified as Rosgen type B4C (Table 1). The active channel contained 29 pieces of LWD, of which 26 (90%) were conifers (Table 4). Out of channel wood totaled 87 pieces, 76 (87%) of which were conifers, and was concentrated in the riparian zone (Table 5).

In-channel LWD density was 72.5 pieces per thousand feet, the highest of any reach, with conifer LWD accounting for 65 pieces per thousand feet. The majority of in-channel LWD (35% overall) was large conifers (greater than 2 feet in diameter) classified as extra and present at a density of 25 pieces per 1000 feet, highest of any reach sampled (Table 6; Fig. 2). A significant portion of the LWD tallied for this reach was contained in a logjam on the right bank that formed in the winter of 1998 (EPA Site Q). The jam was subsequently cleared. The stream has also rerouted around it, leaving much of the LWD stranded in the riparian area as dead/down. Two perched and leaning alders, and two dead/standing alders were tallied, one of which was also leaning. A dead/standing Douglas fir 2-3 feet in diameter was noted less than five feet upstream of sample 2.

Reach 5C. This reach begins approximately 5.3 miles upstream of the mouth and contains 8 samples in 4,417 feet. Here, the floodprone channel is well entrenched (Rosgen channel type B4C, almost F4) but upland slopes were gentler (Table 1). Riparian zone widths increased compared to reaches 5A and 5B (means = 34 feet left bank, 26 feet right bank) and slopes become more moderate (60% on the left bank, 64% on the right bank) (Table 3). A total of 66 pieces of LWD were tallied in the channel, 58 of which (88%) were conifers (Table 4). Out of channel wood totaled 347 trees and logs, 287 of which (83%) were conifers (Table 5).

In-channel LWD density was 41.3 pieces per thousand feet, with conifers accounting for the majority (36.3 pieces per thousand feet). Of the LWD present in the channel, the largest portion (20%) was conifers greater than 2 feet in diameter and less than 20 feet in length, classified as extra in the lowflow channel (Table 6, Figs. 1 and 2).

This reach included EPA sites R through U and two logjams. There was one dead/standing Douglas fir in the upslope which measured 2-3 feet in diameter, and five leaning trees in the perched area (four alders and one redwood).

Reach 6. Beginning approximately 6.1 stream miles upstream of the mouth at Bear Creek (Table 1), this reach was 2,000 feet long and contained four samples. The channel narrows slightly but is somewhat less entrenched than the reaches 5A, 5B or 5C, and has a bedrock substrate (Rosgen type B1). The width of the riparian areas was 17 feet on both left and right bank, with average slopes of 52% on the left bank and 76% on the right bank (Tables 2 and 3). The active channel contained just 22 pieces of LWD, 21 of which were conifers and 14 of which (64%) were classified as extra (Table 4, Figs. 3 and 4). In-channel LWD density was 27.5 pieces per thousand feet. There were 123 logs and trees counted in the out of channel areas, of which 106 (86%) were conifers (Table 5). Conifers were present in roughly equal numbers in the upslope (57 trees, 46% overall) and riparian (45 trees, 37% overall) (Table 5). One dead/standing redwood tree was noted in the riparian, and the reach contained 2 logjams.

Reach 7. This reach, which begins approximately 6.5 stream miles upstream of the mouth, contains two samples in 875 feet. The stream here has a relatively wide lowflow channel but a narrow bankfull channel and very low bankfull width/depth ratio (Table 3). The substrate is almost entirely bedrock chutes and falls (Rosgen channel type A1). Mean riparian widths were very low (20 feet on both banks – Table 3). Right bank slopes became very steep (mean = 101%) but became very flat on the right bank upslope (riparian mean 100%, upslope mean 18%)

at the Gazos Mountain Camp site. There was very little LWD present in the channel; a total of 8 pieces were counted, 7 of which were conifers (Table 4). All LWD in the active channel was classified as extra (Table 6, Figs. 1, 2 and 5), including one redwood root approximately 7 feet in diameter. In-channel LWD density was low (20 pieces per thousand feet). A total of 66 pieces of out-of-channel logs and trees were tallied, 63 of which (95%) were conifers. Conifers were present in roughly equal numbers in the upslope and riparian areas (Table 5). Logjams, leaning and dead/standing trees were not present in the sampled areas.

Reach 8. This reach contained one sample and begins just above the falls near the south fork confluence, approximately 4.2 miles upstream of Old Woman Creek, ending near Gazos Mountain Camp. The channel is entrenched and the substrate is dominated by cobbles (Rosgen B3 channel type). Slopes averaged 80% on the left bank and 120% on the right. Average riparian widths were narrow (25 feet left bank, 15 feet right bank) (Table 3). No LWD was present in the channel in this reach. A total of 26 pieces of out-of-channel wood were tallied, 15 (58%) of which were in the upslope; 10 of these (38%) were conifers (Table 5). No logjams, leaning or dead/standing trees were noted. Approximately 1,000 feet upstream of the end of Reach 8, gradients again steepen to form chutes and falls, and the substrate reverts to bedrock (Rosgen channel type A1).

CONCLUSIONS/ MANAGEMENT IMPLICATIONS

1. LWD in Gazos Creek is relatively abundant compared to the three other coastal streams surveyed, but much of it is small (1-2 feet in diameter, 6-20 feet in length) and not contributing to habitat features.

2. Pools and backwaters were primarily formed by relatively scarce, large (greater than 2 feet in diameter and 20 feet in length), conifer logs and rootwads.

3. Much of the LWD in the channel was small (less than 2 feet in diameter and/or 20 feet in length), located above the lowflow channel, and had little to no effect on habitat on its own. This is especially true for hardwood-derived LWD.

4. Most of the conifer-derived LWD is “old” redwood that appears to be in the channel as a result of past logging or logjam clearing activities.

5. Smaller LWD can have an impact on habitat when it is associated with, or “caught” by, large LWD as part of a logjam.

6. Recruitment sources of new LWD are primarily perched, dead/standing and/or leaning trees, most of which are small hardwoods less than 2 feet in diameter, in particular red alders. Very few dead/standing or leaning conifers were present, and most of these were in riparian or upslope areas, where the likelihood of recruitment is low.

7. Large conifers appear to be recruited only during catastrophic events such as debris flows or large storms such as those that occurred in the 1998 El Niño winter.

8. Substantial improvement in channel LWD densities and the habitat benefits associated with LWD would be most easily accomplished by the addition of large (greater than 2 feet in diameter and/or 20 feet or more in length) conifer trunks and rootwads. This could be achieved by cutting large trees and dropping them into the channel, or pulling them into the channel complete with rootwad, at appropriate locations. During high flows, they would act as "catcher" logs for smaller wood.

9. Addition of LWD from outside the watershed is less practical, as it would necessitate bringing in much smaller wood (in diameter and in length) than what is already available at streamside. This approach would also probably require a great deal of effort, and involve equipment in the channel, in order to place the LWD where it could potentially have the greatest effect.

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TABLE 1. Reach lengths (feet), number of samples per reach, and Rosgen channel classification types for Gazos Creek in 2001.

REACH	LENGTH (feet)	NUMBER OF SAMPLES	CHANNEL TYPE	JJS FISH SAMPLE SITES
1	13,335	13	C5	1, 2
2	4,000	8	C4	2A
3	2,000	4	B4C	2B
4	867	1	B4C	
5A	6,685	13	B4C/ F4	3, 3A
5B	1,148	2	B4C	4
5C	4,417	8	B4C	5,6
6	2,000	4	B1	7A, 7B
7	875	2	A1	
8	400+	1	B3	

TABLE 2. Mean widths (feet) of lowflow and bankfull channels, mean bankfull channel depths (feet), bankfull width/depth ratios and lowflow/bankfull ratios by reach for Gazos Creek in 2001.

	LOWFLOW CHANNEL	BANKFULL CHANNEL		BANKFULL WIDTH/ BANKFULL DEPTH	LOWFLOW WIDTH/ BANKFULL WIDTH
REACH	Mean Width (feet)	Mean Width (feet)	Mean Depth (feet)		
1	8.6	27.7	3.3	8.4	.31
2	10.2	38.1	4.1	9.3	.27
3	9.6	46.3	3.8	12.2	.21
4	10.0	43.0	4.5	9.6	.23
5A	8.1	33.3	4.1	8.1	.25
5B	7.3	32.5	4.3	7.6	.22
5C	10.5	26.8	4.0	6.7	.39
6	12.8	27.5	3.8	7.2	.46
7	12.5	20.0	4.8	4.2	.63
8	11.0	21.0	5.0	4.2	.52

TABLE 3. Mean width (feet) and ranges (sample means) by reach for the riparian border and mean slopes (%) and ranges (sample means for riparian and upslope areas of Gazos Creek in 2001. Reaches 4 and 8 had only one sample; ranges for sample means in these reaches are therefore not given.

	RIPARIAN WIDTH (FEET)				**SLOPE (%)**							
	LEFT BANK		RIGHT BANK		LEFT BANK UPSLOPE		LEFT BANK RIPARIAN		RIGHT BANK RIPARIAN		RIGHT BANK UPSLOPE	
REACH	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
1	52	25-75	33	10-50	57	10-120	57	10-100	35	10-100	49	5-120
2	44	25-75	47	25-75	39	5-150	30	10-110	28	10-50	43	10-100
3	26	20-40	16	10-25	85	40-120	56	10-100	58	10-100	69	55-85
4	30		15		100		45		65		100	
5A	15	5-30	20	10-30	108	30-150	95	50-150	75	30-100	105	45-150
5B	9	5-10	20	15-25	98	75-120	93	85-100	95	90-100	95	55-135
5C	34	15-50	26	15-40	81	25-125	39	20-85	63	25-100	66	10-120
6	17	10-25	17	8-30	54	25-100	50	25-100	63	30-100	88	30-125
7	20	0-35	20	15-25	18	15-20	100	75-150	80	60-100	122	120-125
8	25		15		100		60		120		125	

TABLE 4. Summary of piece counts by type (conifer v. hardwood), function (structure forming v. extra) for in-channel wood (lowflow or bankfull) by reach with category and totals by reach and for the entire stream. No wood was present in the channel in Reaches 4 or 8.

	LOWFLOW CHANNEL				**BANKFULL CHANNEL**				**TOTALS**				
	POOL		EXTRA		BACKWATER		EXTRA		LOWFLOW		BANKFULL		REACH
REACH	CF	HW	CF	HW	CF	HW	CF	HW	CF	HW	CF	HW	
1	4	20	7	2	1	4	5	19	11	22	6	23	62
2	4	3	15	12	0	1	24	6	19	15	24	7	65
3	13	0	10	1	11	1	11	6	23	1	22	7	53
5A	32	5	12	10	12	3	41	14	44	15	53	17	129
5B	8	0	12	0	0	0	6	3	20	0	6	3	29
5C	15	1	25	4	6	0	12	3	40	5	18	3	66
6	4	0	1	1	3	0	13	0	5	1	16	0	22
7	0	0	5	1	0	0	2	0	5	1	2	0	8
STREAM TOTALS	80	29	87	31	33	9	114	51	167	60	147	60	**434**
PERCENTAGES OVERALL:									38%	14%	32%	16%	

TABLE 5. Summary of piece counts by type (conifer v. hardwood) for wood in areas classified as upslope, riparian or perched, by reach with category and totals by reach and for the entire stream.

	UPSLOPE		RIPARIAN		PERCHED		TOTALS		
REACH	CF	HW	CF	HW	CF	HW	CF	HW	REACH
1	18	11	2	110	1	70	21	191	212
2	1	6	14	45	0	57	15	108	123
3	80	8	18	13	12	17	110	38	148
4	33	6	1	7	2	1	36	14	50
5A	189	15	50	46	17	41	256	102	358
5B	26	1	50	4	0	6	76	11	87
5C	195	14	69	34	23	12	287	60	347
6	57	11	45	6	4	0	106	17	123
7	39	1	23	1	1	1	63	3	66
8	10	5	9	2	0	0	19	7	26
STREAM TOTALS	648	78	281	268	60	205	989	551	**1,540**

TABLE 6. Summary of in-channel wood amounts per thousand feet by type (conifers v. hardwoods) and size. Percentages reflect the relationship between the category and the total piece count per reach. No wood was present in the channel in reaches 4 or 8. The majority of the wood tallied for Reach 2 was concentrated within one logjam. Pieces denoted with (*) were judged in the field to be "old."

		LOWFLOW CHANNEL				**BANKFULL CHANNEL**			
		POOL		EXTRA		BACKWATER		EXTRA	
REACH	PIECE SIZE	CF	HW	CF	HW	CF	HW	CF	HW
1	6-20 X 1-2' D	0	1.5-A	2-R*	0.4-A	0	0	0.4-R	3.0-A
	>20 X 1-2' D	0.4-R*	2.3-A, 1.2-M	0	0.4-A	0	0.8-A	0	3.5-A, 0.4-W
	ROOT X 1-2' D	0	0	0.4-R*	0	0	0	0	0
%		2	21	9	3	0	3	2	32
	6-20 X 2-4+' D	0.4-R*	0.4-A	0.4-D*	0	0	0	0.4-R*, 0.4-D*	0
	>20 X 2-4+' D	0.4-R*	1.5-A, 0.4-M	0	0	0.4-R*	0.4-A	0.4-R*	0.4-A
	ROOT X 2-4+'D	0.4-R*	0.4-A	0.4-R*	0	0	0.4-A	0.4-R*	0
%		5	11	3	0	2	3	6	2
2	6-20 X 1-2' D	0.6-R*	1.9-A	1.2-R*	1.2-A	0	0	4.4-R*	0.6-A
	>20 X 1-2' D	0	0.6-A	1.2-R*	3.1-A	0	0.6-A	1.9-R*, 0.6-D	1.9-A, 0.6-M
	ROOT X 1-2' D	0	0	0	0	0	0	0	0
%		1	5	6	11	0	1	17	7
	6-20 X 2-4+' D	1.2-R*, 0.6-D*	0	2.5-R*, 0.6-D	0	0	0	3.8-R*	0
	>20 X 2-4+' D	0	0	3.1-R*	2.5-A, 0.6-M	0	0	4.4-R*	1.2-A
	ROOT X 2-4+'D	0	0	0.6-R*	0	0	0	0	0
%		5	0	17	8	0	0	20	2

TABLE 6 (CONT.)

		LOWFLOW CHANNEL				BANKFULL CHANNEL			
		POOL		EXTRA		BACKWATER		EXTRA	
REACH	PIECE SIZE	CF	HW	CF	HW	CF	HW	CF	HW
3	6-20 X 1-2' D	1.3-R, 1.3-D*, 6.3-R*	0	3.8-R*	0	3.8-R*	1.3-A	3.9-R*, 2.6-D	5-A
	>20 X 1-2' D	1.3-R*	0	1.3-R, 1.3-D	0	1.3-D	0	1.3-D	1.3-A
	ROOT X 1-2' D	0	1.3-A	0	1.3-A	0	0	1.3-R*	0
%		15	2	9	2	7	2	13	9
	6-20 X 2-4+' D	5-R*	0	2.5-R*	0	3.8-R*, 1.3-R	0	2.6-R*	1.3-A
	>20 X 2-4+' D	0	0	0	0	1.3-R*	0	1.3-R*	0
	ROOT X 2-4+'D	1.3-R*	0	3.8-R*	0	2.6-R*	0	1.3-R*	0
%		9	0	9	0	13	0	8	2
5A	6-20 X 1-2' D	0.4-R*	1.2-A	0.8-R*, 0.8-R	1.9-A	1.5-R*	0.4-A	3.8-R*, 0.8-R	2.3-A
	>20 X 1-2' D	0.4-R* 0.4-R 0.4-D	0.8-A	0.4-R*, 0.8-D	1.5-A	0.8-R*	0.4-A	1.2-R, 0.4-R*, 0.8-D 0.8-D*	1.5-A
	ROOT X 1-2' D	0	0	0.4-R*	0.4-A	0	0.4-A	0	0.8-A
%		3	4	6	8	5	2	15	9
	6-20 X 2-4+' D	3.8-R*, 0.4-R	0	0.4-R*	0	0.8-R*	0	3.5-R*	0
	>20 X 2-4+' D	1.5-R*, 0.4-R, 0.4-D	0	0.4-R*, 0.4-D	0	0.4-R*	0	0.8-R*, 0.4-R, 1.2-D	0.4-A
	ROOT X 2-4+'D	3.8-R*, 0.4-R	0	0	0	0.8-R*	0	2.3-R*, 0.8-R	0
%		22	0	3	0	5	0	18	<1
5B	6-20 X 1-2' D	0	0	2.5-R*	0	0	0	2.5-D, 2.5-R	5-A
	>20 X 1-2' D	2.5-D	0	2.5-R	0	0	0	2.5-D	2.5-A
	ROOT X 1-2' D	0	0	0	0	0	0	2.5-D	0
%		3	0	7	0	0	0	14	10
	6-20 X 2-4+' D	5-R*	0	2.5-R*, 12.5-R, 5-D	0	0	0	0	0
	>20 X 2-4+' D	5-R*, 2.5-D	0	5-D	0	0	0	0	0
	ROOT X 2-4+'D	5-R*	0	0	0	0	0	5-R*	0
%		24	0	35	0	0	0	7	0

TABLE 6 (CONT.)

		LOWFLOW CHANNEL				BANKFULL CHANNEL			
		POOL		EXTRA		BACKWATER		EXTRA	
REACH	PIECE SIZE	CF	HW	CF	HW	CF	HW	CF	HW
5C	6-20 X 1-2' D	0.6-R*	0	5.6-R*	0	1.9-R	0	2.5-R*, 1.9-D*	0.6-A
	>20 X 1-2' D	1.3-R, 0.6-D	0	1.3-R*, 0.6-R	2.5-A	0	0	0	1.3-A
	ROOT X 1-2' D	0	0	0	0	0	0	0	0
%		6	0	17	6	5	0	11	5
	6-20 X 2-4+' D	1.9-R*	0	4.4-R*	0	0.6-R*	0	1.9-R*	0
	>20 X 2-4+' D	0.6-R*	0	1.9-R	0	0	0	0	0
	ROOT X 2-4+'D	3.7-R*	0.6-A	0.6-R*	0	0.6-R*	0	1.3-R*	0
%		15	2	20	0	5	0	8	
6	6-20 X 1-2' D	0	0	0	0	0	0	1.3-D	0
	>20 X 1-2' D	0	0	1.3-R	1.3-A	1.3-D	0	2.5-D, 1.3-R*	0
	ROOT X 1-2' D	0	0	0	0	0	0	0	0
%		0	0	5	5	5	0	18	0
	6-20 X 2-4+' D	3.8-R*	0	0	0	2.5-D	0	6.3-R*	0
	>20 X 2-4+' D	1.3-R*	0	0	0	0	0	0	0
	ROOT X 2-4+'D	0	0	0	0	0	0	5-R*	0
%		18	0	0	0	9	0	40	0
7	6-20 X 1-2' D	0	0	5-D*	0	0	0	2.5-D	0
	>20 X 1-2' D	0	0	2.5-D	0	0	0	2.5-D	0
	ROOT X 1-2' D	0	0	0	2.5-A	0	0	0	0
%		0	0	38	12	0	0	25	0
	6-20 X 2-4+' D	0	0	2.5-R*	0	0	0	0	0
	>20 X 2-4+' D	0	0	0	0	0	0	0	0
	ROOT X 2-4+'D	0	0	2.5-D*	0	0	0	0	0
%		0	0	25	0	0	0	0	0

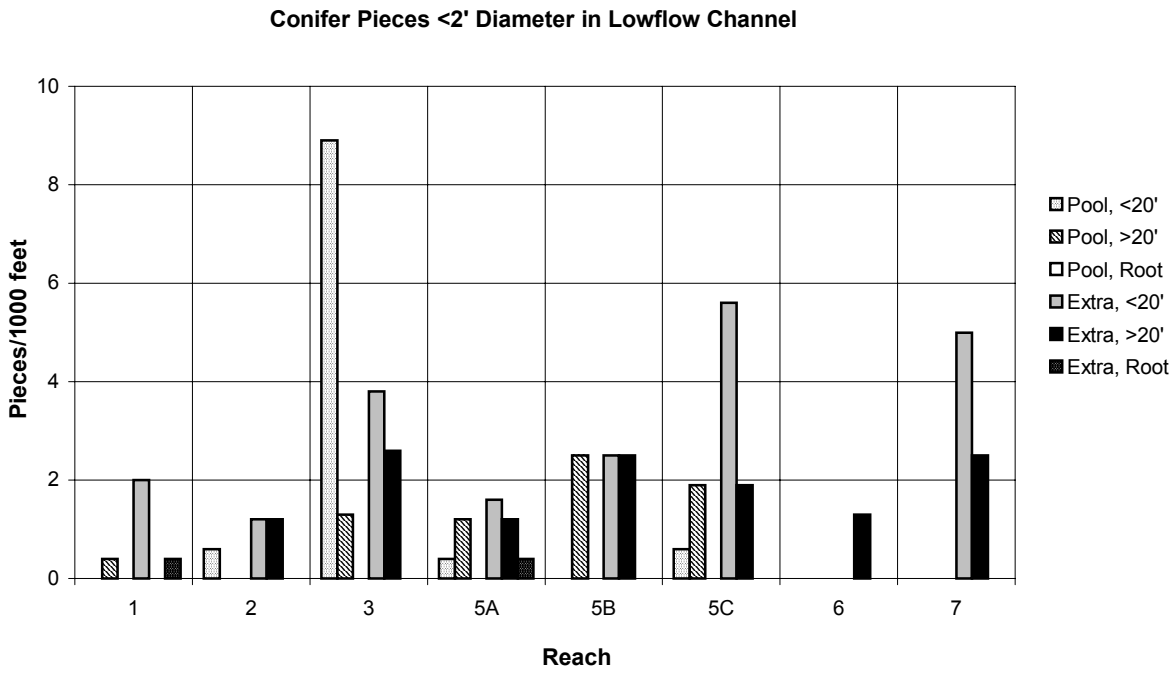

Figure 1. Densities of coniferous LWD with diameters less than 2 feet, tallied in the lowflow channel by reach, length and structure association.

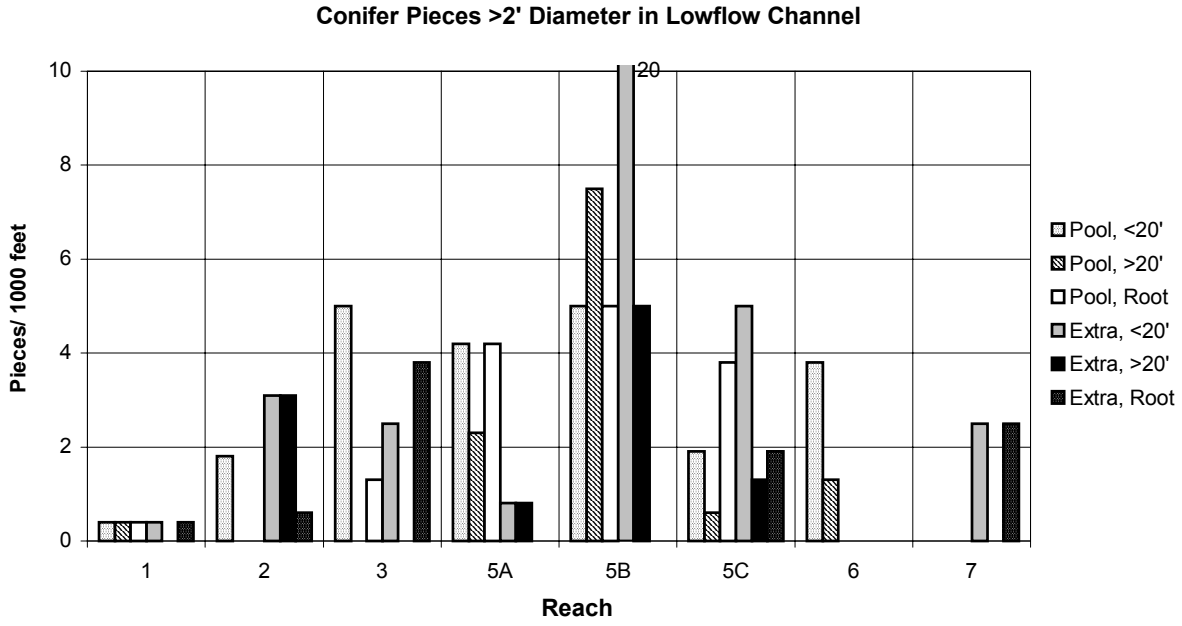

Figure 2. Densities of coniferous LWD with diameters greater than 2 feet, tallied in the lowflow channel by reach, length and structure association.

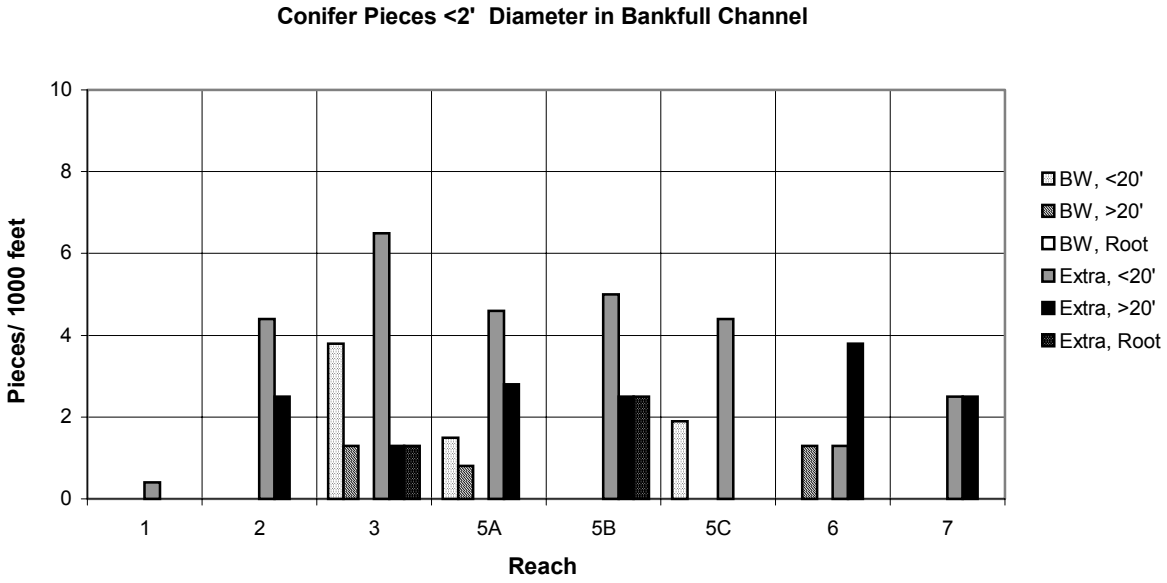

Figure 3. Densities of coniferous LWD with diameters less than 2 feet tallied in the bankfull channel by reach, length and structure association.

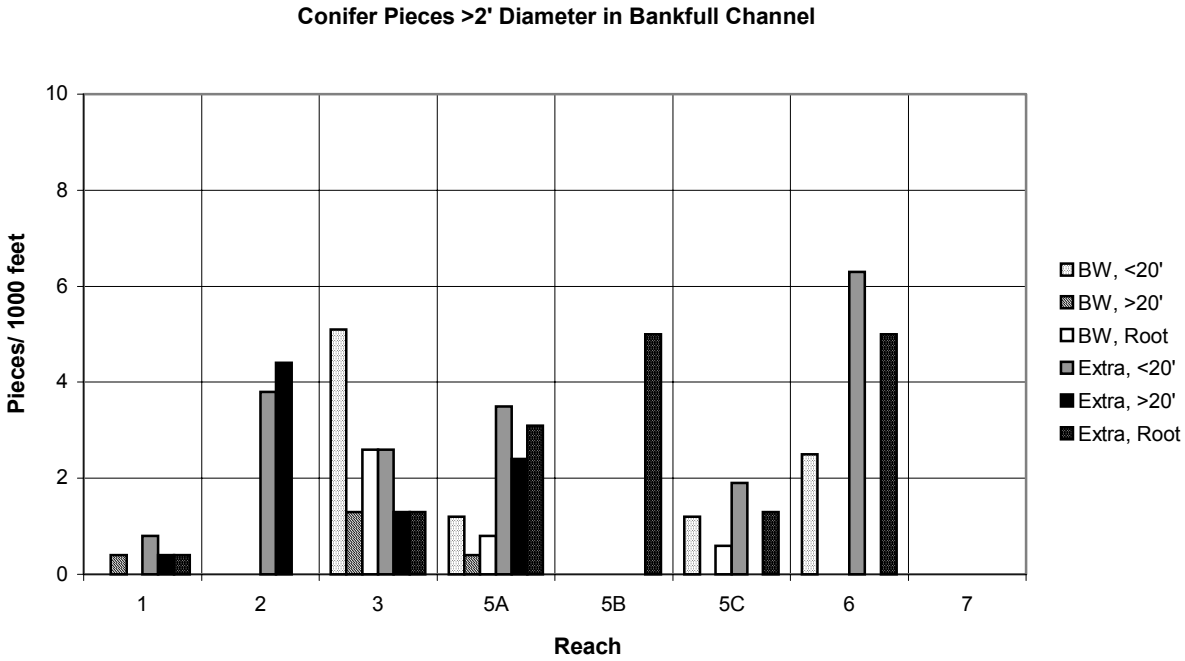

Figure 4. Densities of coniferous LWD with diameters greater than 2 feet tallied in the bankfull channel by reach, length and structure association.

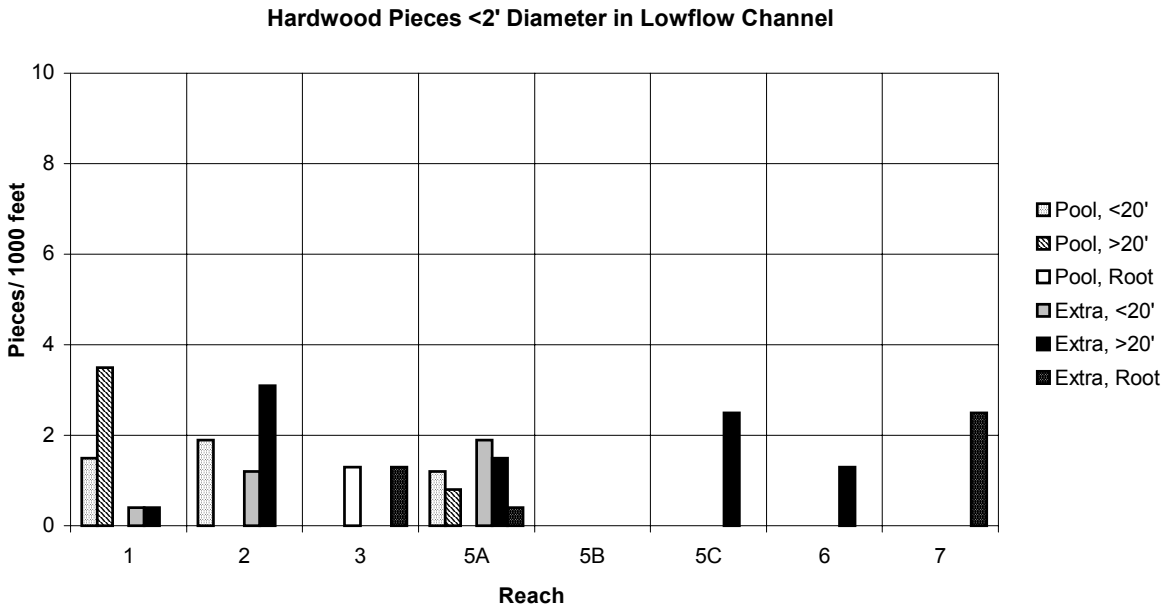

Figure 5. Densities of hardwood LWD with diameters less than 2 feet tallied in the lowflow channel by reach, length and structure association.

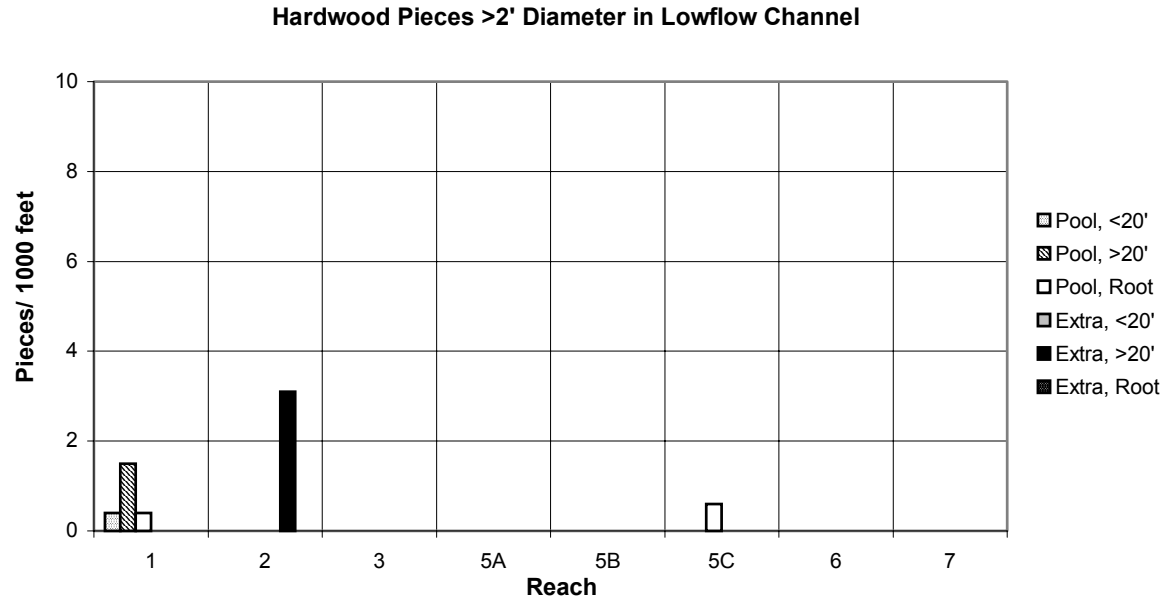

Figure 6. Densities of hardwood LWD with diameters greater than 2 feet tallied in the lowflow channel by reach, length and structure association.

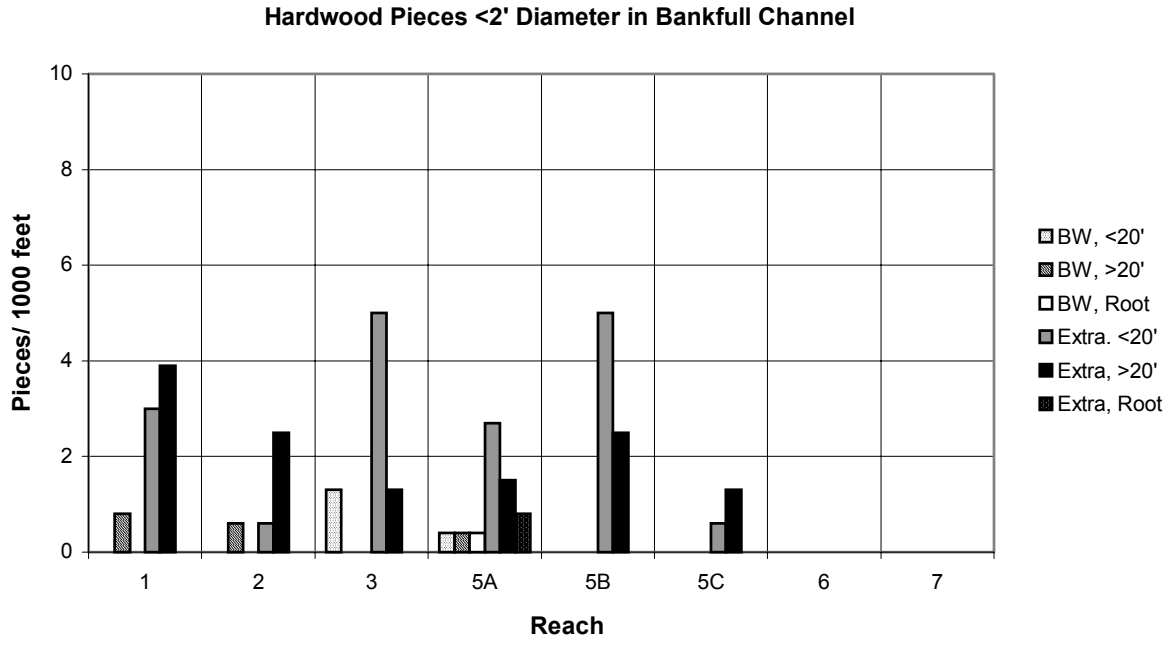

Figure 7. Densities of hardwood LWD with diameters less than 2 feet tallied in the bankfull channel by reach, length and structure association.

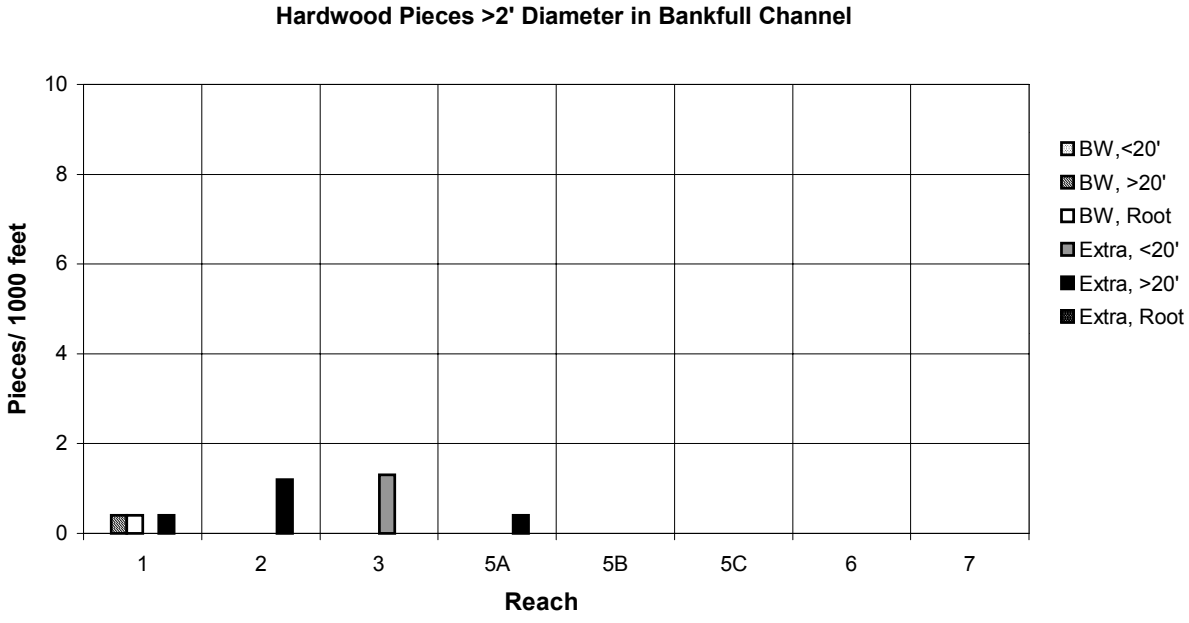

Figure 8. Densities of hardwood LWD with diameters greater than 2 feet tallied in the bankfull channel by reach, length and structure association.